OBSERVATIONS ON THE REPRODUCTION OF *COBITIS PALUDICOLA* DE BUEN, 1930 IN THE JARAMA RIVER.

by

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Résumé. – Le développement de la gonade des femelles de la population de *Cobitis paludicola* du fleuve Jarama a lieu à partir de la fin de Mars, et aucune activité gonadale n'a été observée pendant l'hiver. Le frai est fractionné et il s'étend de Mai jusqu'à Juillet. La relation entre la longueur standard (SL) des poissons et la fécondité (F) est :

Log F = – 3,180 + 3,173 Log (SL)

Summary. – Gonad development of the females of *Cobitis paludicola* in the Jarama river occurs from the end of March onwards, no winter gonad activity being noted. Spawning occurs from May until July and is fractional. Relationships between standard length (SL) and fecundity (F) is given by the equation :

Log F = – 3.180 + 3.173 Log (SL)

Key-words : Spain, Cobitis paludicola, Cobitidae, Fish, Reproduction.

Since the description of *Cobitis paludicola* by de Buen in 1930, very few taxonomic or other observations have been published on this species (Bacescu 1961). This dearth of information is generally the case for all species of Cobitidae in Europe and, especially with regard to reproduction in natural populations, as for example in the different European races and subspecies of *C. taenia* (L.) the only information available is that given by Knaack (1962), Maksunov (1969), Lodi (1967a and b, 1980) and Robotham (1981).

The present work was therefore undertaken, in order to study the population of *C. paludicola* of the Jarama river, with particular reference to gonal development and fecundity.

MATERIAL AND METHODS

Between January 1980 and August 1981, monthly sampling was carried out with electric fishing gear, in the stretch of the Jarama river, above its confluence with the Lozoya river (province of Guadalajara). For the general characteristics

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of the area sampled see Lobón-Cerviá and Torres (1983) and Lobón-Cerviá & Penczak (1984).

The 340 specimens captured for this study, were fixed in 5 % formaline in the laboratory and, several days later, gonads were transferred to Gilson fluid (Bagenal & Braum, 1978).

The low absolute fecundity in this species allows for an accurate estimation of the total number of eggs, for which the gravimetric method was used. The total number of eggs was counted in ten specimens and the error attributable to the method was found not to exceed 5 %. Fecundity was determined in 40 females captured in May, June and July, and monthly frequency distributions of egg diameters were calculated in at least 5 females per month. Diameters were measured in a light chamber in arbitrary units. Further information on the growth, density and production of this population is given in Lobón-Cerviá & Penczak (1984). Standard length (SL) was used for all specimens.

RESULTS

The proportion between sexes in the 340 specimens taken is shown in Fig. 1. All specimens over 6.5 cm S.L. were females, males clearly predominating between 5 and 6 cm.

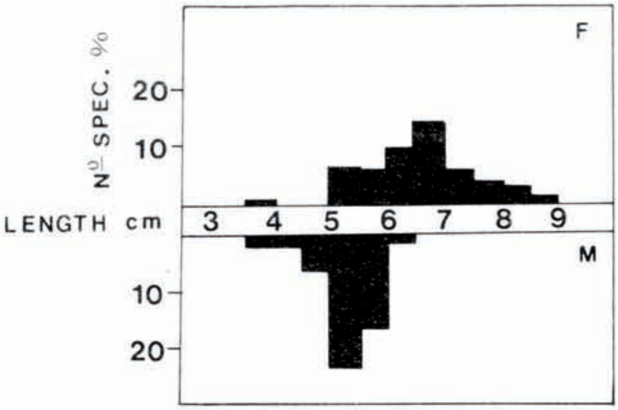

Fig. 1. – Sex-ratio with relation to length in 340 specimens of *Cobitis paludicola*. Pooled monthly samples captured in River Jarama. F = females and M = males.

The gonadosomatic index (Ig), gonads' weight as a percent of body weight, increases proportionally with S.L. in females (Fig. 2) and therefore the seasonal gonadial cycle was studied in females between 6 and 8 cm S.L. (Fig. 3). Males were excluded as manifesting very few changes throughout the year.

Figure 3 shows that the gonads start to develop from the end of March onwards, spawning begining in May and continuing fractionally until late July. From this month onwards there seems to be a quiescent period lasting until the new development of the following year. During winter there does not seem to be any gonadial increase.

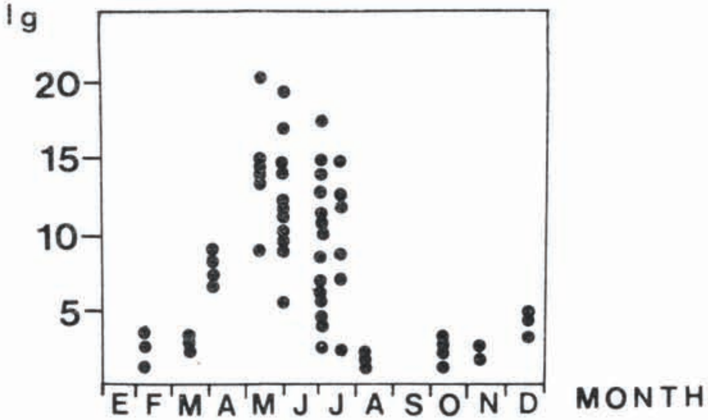

Fig. 2. – Relation between gonado-somatic index (I_g) (log scale) and standard length (L_s, mm) of female *C. paludicola* from River Jarama. ■ December-February, ● June.

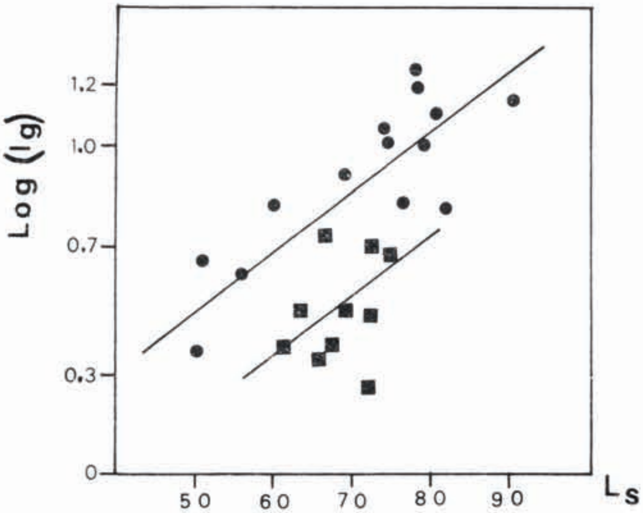

Fig. 3. – Gonad development pattern of female *C. paludicola* from Jarama River. Points represent individual fish.

Analysis of seasonal development in ovum size (diameter) confirms this cycle (Fig. 4). There was a considerable increase in ovum diameter from March onwards and a long spawning period over 60 days (2 months), thus confirming a fractional spawning, no winter activity being evident.

Absolute fecundity (over 8 arbitrary units) determined in females captured throughout this period and estimated for two periods, May-June and July (Fig. 5) has shown that the number of eggs within the 8 arbitrary diameter units was greater in the former period than in the later. This difference, analysed by a co-variance analysis, was significant of $P < 0{,}05$.

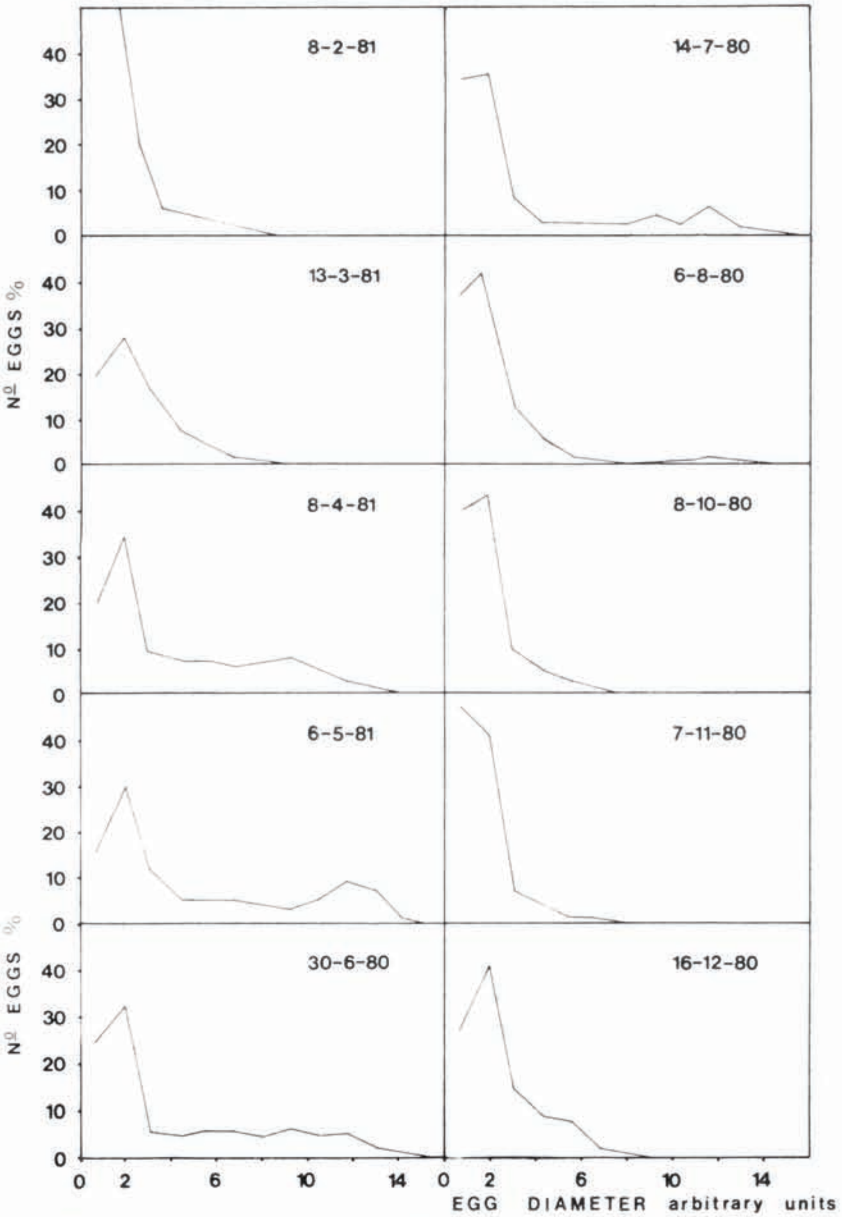

Fig. 4. – Distributions of monthly egg sizes of *C. paludicola* females from River Jarama.

Relations between fecundity and length (SL) in these females were exponential in both cases (May-June and July). The following equations were obtained by the least squares method, on a log : log scale (Fig. 5).

(1) May-June : $\mathrm{Log}\,F = -3.180 + 3.173\,\mathrm{Log}(SL)$ ($r = 0.57$, $P < 0{,}05$)

(2) June : $\mathrm{Log}\,F = -6.678 + 4.941\,\mathrm{Log}(SL)$ ($r = 0.85$, $P < 0{,}01$)

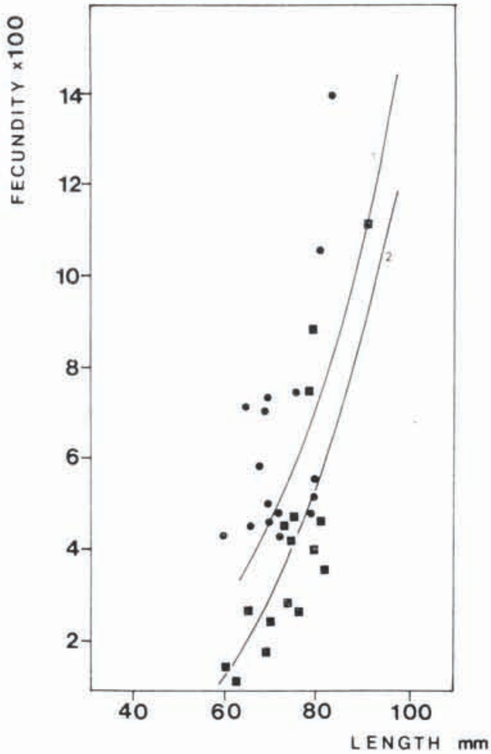

Fig. 5. – Relationships between standard length and fecundity of *C. paludicola* from River Jarama. ● May-June samples, ■ July samples. Equations 1 and 2 in text.

DISCUSSION

Egg development two or three months before spawning has already been described in some species, not only in Cyprinidae like the Gudgeon (*Gobio gobio* L.) (Mann, 1980; Lobón-Cerviá & Torres, 1983) or the European Barbel (*Barbus barbus* L.) (Hancock 1979) but also in other species from different families, such as Pike (*Esox lucius* L.) (Mann, 1976) or *Galaxias vulgaris* Stokell (Cadwallader, 1976). Nevertheless this kind of development, although apparently a general phenomenon, may have some exceptions as is shown by the fact that the iberian Nase (*Chondrostoma polylepis* (Steind.)) develops its eggs gradually throughout the winter and spring (Lobón-Cerviá, 1982)

The proportion of females to males in our samples of *C. paludicola* in the river Jarama, 1 : 0.97 in favour of the females, does not differ significantly from parity and is similar to that found by Gambetta (1934) in Italy and by Robotham (1981) in England for *C. taenia*. However, the dominance of females at the length intervals over 7 cm and their scarcity at the 4-5 cm groups suggest not only a high male mortality at early ages, but also the possibility of sex reversal, already noted by Lodi (1967a and b) in some Italian populations of *C. taenia* and suggested by Robotham (1981) for his British population of the same species.

The larger the female is, the more the eggs and the heavier the mature gonad are. Robotham (1981) has also shown that in his British population of *C. taenia* the diameter of eggs increases with age, but this correlation could not be tested in our population.

Spawning by the Jarama population is fairly long and fractional (Fig. 4 & 5), lasting, as it does, from mid-May until late July. Clearly this period is longer than those put forward by Sterba (1962) (April-June) and Maksunov (1969) (May-June). Fecundity is, in turn, lower than that reported by Gambetta (1934), 1400 eggs being the maximum found in the largest specimen (9 cm) and 400-1100 eggs in 6-8 cm specimens.

Cobitis paludicola has no more than 2-3 reproductive years and the reproductive cost, as measured by means of the gonadosomatic index, does not differ strongly from other cyprinids.

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